

X-ray Timing of Black Holes and Neutron Stars

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Astrophysical compact objects (black holes and neutron stars), the endpoints of stellar evolution and the densest known stars, offer a superb laboratory for exploring a broad range of fundamental physics and astrophysics. The study of rapid X-ray variability and time-resolved spectroscopy of compact object phenomena have extraordinary potential to provide breakthrough discoveries in the coming decades. Promising objectives include:

- Determine the equation of state of ultradense matter in the cores of neutron stars by mapping out the mass-radius relation for neutron stars using a large sample of objects.
- Study the internal structure of neutron stars through asteroseismology by measuring the properties of crustal X-ray oscillations during giant flares from magnetars.
- Measure the spins of stellar-mass and supermassive black holes and look for deviations from the Kerr metric of general relativity using high-frequency quasi-periodic oscillations (QPOs) and time-resolved iron-line spectroscopy of the inner accretion flows.
- Discover the nature of rapid oscillations in accreting black hole and neutron star systems through measurements within a coherence time scale and uncover their connection with fundamental system parameters.
- Determine whether ultraluminous X-ray sources in nearby galaxies contain intermediate-mass black holes by using QPOs and time-resolved iron-line spectroscopy to measure the black hole system parameters.

All of the above objectives could be achieved with missions that have large collecting area, good spectral resolution, and high throughput in the X-ray band.